

Microbial profiling and single-cell transcriptomics reveal probiotic mechanisms of coral thermal resilience

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Probiotics have emerged as a promising approach to improve coral resilience under climate-driven thermal stress, but the mechanisms underlying their protective effects remain largely unclear. In this study, we evaluated two *Endozoicomonas* species as candidate coral probiotics and investigated their effects on both the coral-associated microbial community and host gene regulation. Our results show that *E. acroporae* Acr-14^T enhances thermal tolerance in *Stylophora pistillata* by suppressing opportunistic pathogens while enriching beneficial microbial taxa. To support in-depth transcriptomic analysis, we generated a chromosome-level genome assembly of *S. pistillata* clade 1, which revealed that Acr-14^T alleviates heat-induced protein-folding stress in the host. In addition, single-cell transcriptomic analysis uncovered activation of pro-survival signaling pathways and modulation of the S-adenosylmethionine (SAME) biosynthesis pathway. Together, these findings identify *E. acroporae* Acr-14^T as a promising coral probiotic and provide mechanistic insights into host–microbe interactions that enhance coral resilience under thermal stress.